Remarks

Reconsideration of the claims and allowance of the application are respectfully requested. Claims 1, 2, 9-11, 16, 17, 24-26, 31, 32 & 39-41 remain pending.

Claims 1, 16 & 31 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the present invention. This rejection is respectfully traversed. For convenience, claim 1 is repeated below:

A method of reducing data movement within a computing environment, said method comprising:

> transmitting data between a file system of a server of said computing environment and a transmission medium of said computing environment, said transmitting being responsive to a request for transmission received by the server, wherein said server includes at least one file system buffer and at least one server buffer, said at least one server buffer residing outside the file system of the server,
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> wherein said transmitting comprises at least one of:
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> receiving said data by said file system from a sender, said receiving comprising swapping one or more buffers of the at least one file system buffer with said one or more buffers of the at least one server buffer; and
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> sending said data from said file system over said transmission medium to a receiver of said data, said sending comprising executing, by the file system, a callback function referenced by said request to send said data directly over the transmission medium from the one or more buffers of the at least one file system buffer, and
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> wherein said swapping and said executing the callback function facilitate reducing data movement in said server by bypassing copying the data between one or more buffers of the at least one server buffer and the one or more buffers of the at least one file system buffer in performing the transmission, said copying the data

being bypassed without the server having advance notice of a pattern of access of the data in the file system.

Initially, the Office Action objects to applicant's recited characterization that "wherein said swapping and said executing the callback function facilitate reducing data movement in said server by bypassing copying of the data between one or more buffers of the at least one server buffer and the one or more buffers of the at least one file system buffer ...". Applicant respectfully submits that this wherein statement in the independent claims further characterizes both the swapping function and the executing of the callback function. In both the swapping and the executing, reduction in data movement is accomplished by bypassing copying of data between the specific buffers recited. That is, the wherein statement further expresses the result of the swapping and the executing of the callback function recited earlier in the claim. In view of this, reconsideration of the indefiniteness rejection is requested.

Next, the Office Action alleges that it is unclear in which direction data is moving, as for example, in a read or a write request. This rejection is also respectfully traversed. Applicants claim "transmitting data between a file system of a server of the computing environment and a transmission medium." Applicants respectfully submit that the word "data" can be read in plural form, with the phrase "transmitting data" read to include transmitting one or more units of data. This transmitting can thus be accomplished as either a read operation, a write operation, or both read and write operations for different portions of data within the data being transmitted. In accordance with applicant's independent claims, the transmitting includes at least one of receiving the data by the file system from a sender, with the receiving including swapping one or more buffers of the at least one file system buffer with one or more buffers of the at least one server buffer, and sending the data from the file system over the transmission medium to a receiver of the data, the sending including executing, by the file system, a callback function referenced by the request to send the data directly over the transmission medium from the one or more buffers of the at least one file system buffer.

In the case of receiving data, the file system is receiving data from over the transmission medium, and thus, receiving the data including swapping the buffers would be

read by one of ordinary skill in the art to be accomplished during a write operation. Similarly, the sending of data from the file system over the transmission medium to a receiver, would be read by one of ordinary skill in the art to be accomplished in conjunction with a read operation. Thus, because data is plural, applicant recites novel functionality for moving data in conjunction with receiving the data (during a write operation) or sending the data (during a read operation). The independent claims recite functionality for moving data in both directions depending upon whether data is being moved from the transmission medium to the file system or from the file system to the transmission medium.

Additionally, applicants respectfully traverse the characterization that the server can be the "sender" or the "receiver". In applicants independent claims, functionality is recited for transmitting data between a file system of a server and a transmission medium. The file system is recited to be "of a server of the computing environment". Thus, in applicants claims, data moves between the file system of the server and a transmission medium of the computing environment, with the sender and the receiver communicating over the transmission medium.

To summarize, the independent claims presented particularly point out and distinctly claim the subject matter which applicant regards as the present invention. This is true particularly when read by one of ordinary skill in the art and in light of applicant's specification. The "data" recited by applicant is a plural form of the word meaning that transmitting occurs for multiple pieces of data, and meaning that different pieces of data may be read, while others written. Thus, applicant's transmitting is recited to include "at least one of" functionality for receiving data by the file system (i.e., during a write function) and sending the data from the file system over the transmission medium to a receiver (i.e., during a read operation). For all of the above reasons, applicant respectfully requests reconsideration and withdrawal of the 35 U.S.C. § 112, second paragraph, rejection to independent claims 1, 16, & 31.

Substantively, claims 1, 2, 9-11, 16, 17, 24-26, 31, 32 & 39-41 were rejected under 35 U.S.C. 103(a) as being unpatentable over Burnett et al. (U.S. Patent No. 6,006,018; hereinafter, "Burnett") in view of Hamilton et al. (U.S. Patent No. 5,799,150; hereinafter, "Hamilton"); and claims 1, 2, 9-11, 16, 17, 24-26, 31, 32 & 39-41 were rejected under 35

U.S.C. 103(a) as being unpatentable over applicant's admitted prior art in the background in view of Ledain et al. (U.S. Patent No. 6,021,408; hereinafter, "Ledain") and Hamilton. Each of these rejections is respectfully traversed and reconsideration thereof is requested.

An "obviousness" determination requires an evaluation of whether the prior art taken as a whole would suggest the claimed invention taken as a whole to one of ordinary skill in the art. In evaluating claimed subject matter as a whole, the Federal Circuit has expressly mandated that functional claim language be considered in evaluating a claim relative to the prior art. Applicant respectfully submits that the application of these standards to the pending independent claims leads to the conclusion that the recited subject matter would not have been obvious to one of ordinary skill in the art based on the applied art.

Applicant recites a technique for reducing data movement within a computing environment (e.g., claim 1). The technique includes transmitting data between a file system of a server of the computing environment and a transmission medium of the computing environment, the transmitting being responsive to a request for transmission received by the server. The server includes at least one file system buffer and at least one server buffer residing outside the file system of the server. The data transmission includes at least one of: (1) receiving the data by the file system from a sender, wherein the receiving includes swapping one or more buffers of the at least one file system buffer with the one or more buffers of the at least one server buffer; and (2) sending the data from the file system over the transmission medium to a receiver of the data, wherein the sending includes executing, by the file system, a callback function referenced by the request to send the data directly over the transmission medium from the one or more buffers of the at least one file system buffer. The swapping and the executing of the callback function facilitate reducing data movement in the server by bypassing copying the data between one or more buffers of the at least one server buffer and the one or more buffers of the at least one file system buffer in performing the transmission. This copying of the data is bypassed without the server having advance notice of a pattern of access of the data in the file system.

Applicant's invention thus recites, in part, swapping file system buffers with server buffers (e.g., during a write operation) or executing a callback function to send data directly over the transmission medium from file system buffers (e.g., during a read operation) to

facilitate reducing data movement in the server by bypassing the copying of data between file system buffers and the server buffers. Further, the copying of data is bypassed without the server having advance notice of a pattern of access of the data in the file system. Advantageously, this avoidance of data copying between the server and file system buffers reduces data movement in the server and enhances response time. Applicant respectfully submits that at least these features of the claimed invention are not taught, suggested or implied by Burnett, Hamilton, applicant's admitted prior art, or Ledain, either alone or in combination.

Burnett discloses a Distributed File System (DFS) translator technique that provides authenticated access to files stored in a target distributed system in response to requests from clients in a source distributed file system. The technique includes mapping credentials associated with the request into enhanced credentials that include authentication information (see Abstract thereof). In Burnett, a remote access of a file occurs through a two-step caching process whereby a server node retrieves the file and stores it in a server cache, and a client node goes out over the network, retrieves the file and stores it in a client cache (see FIG. 1; col. 4, lines 44-66). This is very different from the data transmission's functionality and the bypassing of the copying of data recited in the claims presented.

For example, applicant recites transmitting data between a file system of a server and a transmission medium that includes at least one of receiving the data by the file system from a sender and sending the data from the file system over the transmission medium to a receiver. Again, the transmitting is responsive to a request for transmission received by the server. The receiving includes swapping one or more file system buffers with one or more server buffers. For example, during processing an operation that writes data to a disk coupled to the file system of the server, the data is sent from a sender (e.g., a client) and a write routine is called (e.g., pfs_write) with pointers to server buffers that are compatible with file system buffers (e.g., the server buffers have page aligned offsets that conform to the page alignments of the file system buffers). In this example, instead of data being stored in the server buffers and then copied (i.e., moved) to the file system buffers, the copy is avoided (i.e., bypassed) by swapping the file system buffers with the server buffers. That is, the pointers to the server buffers are switched to the file system buffers (see, e.g., page 29, line 1 – page 30, line 11 and 1030 of FIG. 10B of the specification).

As another example, during processing of a read operation, a read routine is called (e.g., pfs_read) with input that includes a pointer to a callback function. The file system then executes the callback function with the addresses of the file system buffers that contain the data being read. In this example, the execution of the callback function allows the data to be sent directly (e.g., without being copied to server buffers) from the file system buffers over the transmission medium to a receiver (e.g., a client) (see, e.g., p. 25, line 15 – p. 26, line 5 and 922 of FIG. 9B).

In contrast, the description of buffers in Burnett does not teach or suggest the above-described functionalities of data transmission (i.e., buffer swapping and callback function execution) for reducing data movement in a server by bypassing data copying between server buffers and file system buffers of the server. Instead, Burnett discloses client buffers that allow access to remote files (i.e., files residing on the server) to reduce network traffic and overhead (col. 4, line 64 – col. 5, line 2) without describing or suggesting the buffer swapping or callback function execution functionalities recited by the present invention.

Further, the bypassing of copying between the server buffers and file system buffers in the present invention is accomplished without the server having advance notice of a pattern of access of the data in the file system. For example, without knowing what data is to be accessed by future requests, data movement can still be reduced in the server by the above-noted bypassing of copying.

In contrast, the server in Burnett having or not having advance notice of a pattern of access of data in a file system is simply not discussed. For example, the advantageous reduction of network traffic and overhead in Burnett is not associated with the server having (or not having) such advance notice. Instead, this advantage of Burnett is associated with a client node storing blocks of a remote file into a client cache, as the remote file existed in a server cache (col. 4, lines 60-63).

The Office Action cites col. 5, lines 4-7 & 26-27; col. 4, lines 44-45, 49-60 & 65-66; and col. 5, line 61 – col. 6, line 27 of Burnett in support of the rejection. These sections describe data transmissions of read and write operations, as well as clients and servers and their associated caches. Applicant respectfully submits that the data transmissions described therein do not teach or suggest the above-noted functionalities of the data transmission

recited in the claims presented herewith. For example, col. 4, lines 65-66 discusses an access of data in a client cache instead of going across the network to access the server without describing or suggesting the buffer swapping or callback function execution functionalities of the server recited by the present invention.

The Office Action expressly recognizes that Burnett does not teach all aspects of the present invention and notes that bypassing of buffers per se is at least not taught, suggested or implied by Burnett. Hamilton is thus cited in combination with Burnett.

Hamilton does not overcome the deficiencies of Burnett as applied to the present invention. Hamilton describes a distributed multimedia system which enables real-time transmission of broadcast quality media data over a network (col. 3, lines 38-40 thereof). Prior to a server receiving a client's request to read media data, the Hamilton technique creates and populates a TrackList data structure residing on the server to store the media data that the client will need (col. 6, lines 32-36; col. 7, lines 6-10). The TrackList also allows the server to perform read ahead operations to satisfy subsequent read requests (col. 7, lines 21-28). Processing these read requests results in, for example, audio/video playback wherein data is transmitted directly to "user level" memory buffers of the client (col. 6, lines 5-7; col. 10, lines 3-6). This playback scheme is very different from applicant's invention.

For example, as noted above, applicant's claimed invention recites, in part, transmitting data that includes swapping file system buffers with server buffers or executing a callback function to send data directly over the transmission medium from the file system buffers, wherein the swapping and the executing of the callback function each facilitate reducing data movement in the server. As described above, this data movement reduction is accomplished by bypassing copying the data between server buffers and file system buffers of the server.

In contrast, Hamilton fails to teach or suggest such functionalities of a data transmission, let alone such functionalities used to facilitate reducing data movement in a server by bypassing data copying between the above-described buffers. When the Hamilton technique directly transmits media data to a user level memory buffer, it bypasses copying media data to system memory buffers (col. 6, lines 3-7; col. 9, lines 57-67). However, this buffer copying avoidance is quite different from the bypassing of copying data between the

buffers recited in the present invention. In Hamilton, the bypassed system memory buffers are not the result of data transmission that includes buffer swapping or the execution of a callback function. Further, the bypassed system memory buffers reside on the client side (col. 6, lines 6-7). The bypassed non-file system buffers of applicant's claimed invention reside on the server (see, e.g., claim 1). Moreover, since the buffer bypassing in Hamilton occurs at the client, the resulting data movement reduction is also limited to the client side (Abstract; col. 6, lines 3-7). Applicant's invention, on the other hand, recites reducing data movement in the server.

Further, Hamilton fails to teach or suggest the bypassing of copying data between server buffers and file system buffers of a server, without the server having advance notice of a pattern of access of the data in the file system. Hamilton's playback data transmission results from the server using the predictive information of the TrackList to perform read aheads to satisfy current and subsequent client read requests (col. 7, lines 19-28). Thus, Hamilton relies on the server having advance notice of the pattern of data access determined by the client's read requests.

In addition, the bypassed system memory buffers reside on the client side in Hamilton. In Hamilton, the client knows that a reply from the server is coming and the client uses that knowledge to avoid a buffer move. Thus, because the buffer bypassing function taught by Hamilton requires advance knowledge by the client and the server, and because the bypassing occurs at the client, applicant respectfully submits that Hamilton does not teach or suggest bypassing copying data between server and file system buffers without the server having advance notice of a pattern of access of the data in the file system as recited in the independent claims.

In the Office Action, col. 9, lines 59-67 and col. 10, lines 2-6 & 34-39 are cited as teaching bypassing non-file system buffers. The referenced sections describe bypassing system memory buffers, but the related discussion indicates that these buffers are bypassed in the client rather than the server (see also col. 10, lines 3-6 and FIG. 7 of Hamilton). Thus, this section of Hamilton does not teach or suggest reducing data movement on a server by bypassing the copying of data between server buffers and file system buffers of the server, as recited by the claims presented herewith.

Based on the foregoing, it is believed that Burnett and Hamilton each fail to teach or suggest multiple features recited by applicant. For example, applicant submits that the applied art does not teach or suggest transmitting data including the functionalities of swapping buffers or executing a callback function, wherein these functionalities reduce data movement in the server by bypassing copying the data between server buffers and file system buffers. As another example, the applied art fails to teach or suggest bypassing the copying of the data without the server having advance notice of a pattern of access of the data in the file system. Thus, applicant respectfully submits that the combination of Burnett and Hamilton also fails to teach, suggest or imply at least the above-referenced feature.

Relative to the second obviousness rejection described above, applicant respectfully submits that the above-noted features of the present invention are not taught, suggested or implied by applicant's admitted prior art, Hamilton or Ledain, alone or in combination.

The above-summarized features have been discussed above relative to Hamilton. Therefore, the following remarks focus on the deficiencies of applicant's Background Art and Ledain relative to the claims presented herewith.

Applicant's Background Art describes a Distributed File Services (DFS) system, in which data is moved from one set of buffers within the server to another set of buffers within the server. These data movements increase processing time at the server, thereby negatively affecting response time of requests (e.g., read and write requests) (see applicant's specification at page 2, lines 12-19). This data movement (i.e., copying) between sets of buffers within the server that is present in the prior art is expressly avoided (i.e., bypassed) in the present invention (see, e.g., claim 1). Thus, the background art does not teach or suggest a technique for bypassing the copying of data between server buffers and file system buffers. Moreover, applicant respectfully submits that the background art does not describe or suggest a scheme for transmitting data between a file system of a server and a transmission medium that includes at least one of the above-described swapping and callback function executing, reducing data movement in a server by bypassing the above-noted copying, or for bypassing such copying without the server having advance notice of a pattern of access of the data in the file system. These features lacking in the background art are also not taught, suggested or implied by Hamilton or Ledain.

Ledain describes a log-structured file system including a disk with the main file system and multiple log disks. File write operations store file and system data to the log disks rather than to the main file system. A control program in Ledain manages the migration of the previously written data from the log disks to the main file system (see Abstract and col. 5, lines 36-61 thereof). Thus, Ledain's technique improves file writing speed at the expense of extra disk space. Applicant respectfully submits that Ledain's subject matter is quite different from the present invention.

For example, the data transmission of the present invention includes at least one of the above-noted buffer swapping and the execution of the callback function. Not only is Ledain silent as to these recited functionalities of the transmission of the data, but Ledain also fails to teach or suggest such functionalities to facilitate reducing data movement in the server, or reducing data movement by bypassing copying the data between server buffers and file system buffers. Instead, Ledain is directed to avoiding writing to a file system disk.

Further, the present invention recites that the copying of data is bypassed without the server having advance notice of a pattern of access of the data. The Office Action cites col. 9, lines 25-29 and col. 8, lines 23-26 of Ledain as teaching routing of data through buffers without knowledge. These sections of Ledain address data passing to a buffer for temporary storage and describe log disk data that allows for storage of file and system data within a file system (see also Abstract thereof). Applicant respectfully submits that the existence of log disk data implies a storage mechanism without any suggestion of a server having no advance notice of a pattern of data access. Thus, it is respectfully submitted that Ledain does not teach or suggest copying the data being bypassed without the server having advance notice of a pattern of access of the data in the file system. Further, Ledain does not describe or suggest bypassing server buffers, nor bypassing such buffers for the purpose of reducing data movement in the server.

Since applicant's stated prior art, and the Hamilton and Ledain patents each fail to teach or suggest multiple features of applicant's claimed invention, the combination thereof also fails to teach or suggest multiple aspects of applicant's claimed invention.

For the above reasons, applicant respectfully submits that independent claims 1, 16 & 31 recite patentable subject matter. The dependent claims at issue are believed patentable for

the same reasons as the independent claims from which they directly or ultimately depend, as well as for their own additional features.

Withdrawal of the rejections and allowance of all pending claims are respectfully requested.

Should the Examiner wish to discuss this case with applicant's attorney, the Examiner is invited to contact applicant's representative at the below-listed number.

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